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PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Electric Hoist

We, DEMAG-ZUG G.M.B.H., of Wetter/Ruhr, Germany, a German Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and 5 the method by which it is to be performed, to be particularly described in and by the following statement: —

The invention relates to an electric hoist constructed as an electric pulley block and 10 provided with a motor with displaceable armature, which is of light weight and small dimensions. These characteristics are particularly desirable in cases where it is necessary for the hoist to be readily portable.

If it was desired to provide a hoist of this 15 type with inching lift speed, the aim above referred to could not be achieved if the hitherto used means were provided, that is to say, if an additional inching motor for the lift and the planetary gears or couplings required between the inching motor for the lift and the main gear shaft were provided, because this would mean a substantial increase in the 20 weight and dimensions of the hoist.

In order to avoid these disadvantages, 25 change-pole motors in "Dahlander" circuit were provided, but the result of such a connection would be a speed-ratio of 1:2, at which ratio either the lifting speed would be too low, or the inching lift speed too high.

By "Dahlander" circuit we mean a circuit 30 by which a three-phase motor is adapted to rotate at two speeds in the ratio of 1:2, under the control of an external switch. This is obtained by the windings of each of the three 35 phases being tapped in the centre so that in one switch position the two winding parts of each phase may be connected in parallel in a "Y" circuit, and in another switch position the two winding parts of each phase may be connected in series in a branch of a "Delta" circuit. In this manner the number of poles 40 may be changed with consequent variation of the rotational speed of the armature.

The motor on the hoist according to the 45 invention is preferably of that kind in which the armature is provided to be frusto-conical

and in which eddy currents pass between the stator windings and the armature to release the brake, a spring operating to apply the 50 brake when the current is cut off.

According to the invention the motor is provided with one winding for the main lift and a second winding for the inching lift, the 55 respective speeds of the windings being in the ratio of 1:4 or greater, and both windings acting on the same conical armature of the motor which operates the brake and being mounted in such manner as to generate approximately equal forces of displacement.

In this manner an inching lift is obtained 60 without an additional motor, additional couplings, planetary gears and the like having to be provided, so that there is no substantial increase in the dimensions of the hoist. Thus, it is now possible to use the small electric hoist with inching drive in all those cases in which hitherto the projecting inching drive means made the motor unwieldy and bulky, for example where space was limited. In the 65 hoist according to the invention, the main motor, the inching motor for the lift, and the brake magnet are combined in a single motor, as the change-pole motor according to the invention is provided with a displaceable armature as previously described.

In electric hoists or pulley blocks, in which 70 the motor is mounted in the drum, it is known to use a change-pole motor with two windings, not only for lifting the load at the normal lifting speed, but to lift it also at a higher speed. Then because of the higher power required at the higher lifting speed, the change-pole motor has to be much larger. However, it is an object of the invention to 75 avoid an increase in the dimensions of the hoist when an inching lift device is provided.

It is also known to use in hoists change-pole motors with two windings, in which 80 similarly the lower speed is used for the inching lift. However, in these hoisting winches conditions are different because the motor, the gearing and the winding drum are provided side by side, and are considerably 85

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- more powerful, so that, in contrast to the compact construction of electric hoists, space or other difficulties are experienced when a motor is used the dimensions of which are substantially increased by a higher power.
- During development of the invention, it was at first thought to be risky to use a motor with change-pole control and displaceable armature in view of the danger of the brake snapping-in when the speed was changed, because at the moment of change-over the motor was without current. This unintended braking had to be avoided. Moreover, in spite of the different windings being provided, the required power of displacement had always to be available. It has been found that it is possible to meet these conditions. For this purpose, it is advantageous in the first position to connect the connection contacts to the mains by means of a two-stage hand switch, controlling in the second stage the contact of a change-over relay which interrupts the current flowing to one stator winding and conducts it to the other stator winding. The hoist limit switches may be mounted in the circuit between the hand-operated switch and the change-over relay.
- For the reasons hereinbefore referred to, the motor is constructed as small as possible, that is to say so as to provide a motor adapted to operate at the highest possible speed. However, this involves difficulties, for due to the high speed on the one hand, and the low lifting speed of these small hoists on the other, it is necessary to insert gearing with a large transmission ratio; if this were done, however, the greater part of the gain obtained, when a motor of the kind referred to is provided, would be lost.
- In order to overcome this difficulty, the invention includes the further features that a roller chain is employed as the hoisting means, and a double-winding motor having a maximum speed of 3000 rev./min. is provided to drive a sprocket wheel and thus move the roller chain. The roller chain influences the transmission from the 3000 rev./min. motor to the hoisting means insofar as it enables the driving means for the hoisting means to be provided of a very small diameter so that, as it were, a greater part of the transmission is saved in view of the small diameter of the sprocket wheel. Thus, even though a 3000 rev./min. motor is used, it is nevertheless possible to provide a very simple transmission gearing consisting only of two pairs of gears.
- It is known to provide lifting devices with roller chains. However, these lifting devices have the disadvantage that their lifting speed is too low for many purposes; moreover it is necessary to provide a large transmission gearing having corresponding gears which are inconveniently large, or to provide an undesirably large number of gears in order to obtain the desired reduction in speed. If the transmission gearing is smaller, the inching speed is too high so that accidents may easily occur, or at least time will be lost by up-and-down manouvreing of the load-hook.
- A longitudinal section and a cross-section of a small electric hoist having the characteristic features of the invention are diagrammatically illustrated respectively by way of example in Figures 1 and 2 of the accompanying drawings, and a circuit diagram is shown in Figure 3.
- Referring to the drawings, the motor 2, which is provided with a displaceable armature and constructed with two windings and a brake 3 is flanged to the actual hoist housing, 1. The motor 2 by means of the gear wheels 4, 5, 6 and 7 drives the sprocket wheel 8 which drives the roller chain 9. The electrical switch gear is mounted in that part of the hoist denoted by 10. The hoist limit switch, also provided in part 10 of the hoist, is actuated by the switch spindle 11, the free end of which spindle carries a bracket-like control member 12, the flange 12a of which engages the loop formed by the slackness of the non-loaded part of the chain. The loop, which becomes shorter when the load hook is lowered and when the chain runs-off from the chain magazine 13, engages the member 12 which is thus moved in the direction of the arrow, so that the motor is switched off. The member 12 is integral with a member 14 provided to limit the upward movement of the load hook, and the members 12 and 14 together form a two-armed lever. When the member 14 is contacted by the load hook, the two-armed lever is pivoted in the direction opposite to that of the arrow, and the motor is stopped by the actuation of the limit switch. When the force exerted on the lever either by the loop of slack chain or by the load hook is removed, the lever is returned to its inoperative position by means not shown in the drawings, so that the supply of current to the motor is resumed.
- The motor is controlled in the manner illustrated in the circuit diagram as follows:
- The motor 2 has two windings 15 and 16 respectively for the main speed and for the inching speed. Either winding can control the armature 2a. A hand-operated switch 18, for controlling the operation of the motor, comprises a push button 19 which can move the three contact strips 21 to 23 and a push button 20 which can move the contact strips 23 to 25 respectively, which switch 18 is suspended by the cable 17 (Figure 1). The motor is driven by three phase current, the lead R of the first phase is connected directly to the position 26, while the leads S and T of the second and third phases are connected to the contact strips 21 and 25, and 22 to 24 respectively. For example, when the push button 19 on the left is moved to the left, the contact strips 24 and 25 will first contact the counter-contacts 27 and 28. The current will then flow

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- from the contact strips through the hoist limit switch 29 provided for the lowering operation, to the points 30 and 31 of a change-over relay 32, from which the current is passed to the inching speed winding 16 of the motor 2. As the winding 16 is Y-connected, the phases are interconnected by means of the strip or bar X, Y, Z.
- When the push button 19 is further moved to the left the contact strip 23 contacts the plate 33 and excites the coil 34, thus moving the uppermost switch blades in the direction of the arrow, and switching the change-over relay 32 to the winding 15 of the motor 2.
- The contacts 24, 27 and 25, 28 then remain closed. The whole switching operation in one direction of movement of the motor is thus effected by a single two-way push button switch. When switching in the opposite direction, that is to say, with the motor reversed, the push button 20 is moved to the right, so that the switch steps previously described are repeated with contacts 21, 22 making the initial contact. The limit switches 29 and 35, which in this construction are provided separately for the two directions of movement of the load hook, are connected in the circuit between the hand-switch and the change-over relay so that they switch off current and stop the motor irrespective of which of the motor windings is switched-on at the time. The motor may be started in the opposite direction when the appropriate limit switch has responded to pressing of the respective push button.
- The invention may be developed and modified in many respects; thus, for example, each of the two windings 15 and 16 may be provided with change-pole control in "Dahlander" circuit, four different speeds of the same motor will then be obtained. The inching lift winding of the motor may have at least eight poles.
- What we claim is:—
1. An electric hoist or pulley block comprising an electric motor with an axially displaceable armature, two sets of windings which are controlled by a switch and are adapted to displace the armature, one set of the windings providing a main lift and the second set an inching lift, the armature speeds obtained by the main lift and inching lift windings being in the ratio of 1 to 4 or higher, and a brake adapted to be operative when the flow of electric current to drive the motor is interrupted.
 2. An electric hoist or pulley block according to claim 1, in which the two sets of windings each effect equal or substantially equal axial displacement of the armature.
 3. An electric hoist or pulley block according to claim 1 or claim 2, in which a frusto-conical armature is provided.
 4. An electric hoist or pulley block according to any of the preceding claims, in which the brake is magnetically operated and in which a spring is effective to displace the armature for operation of the brake when the flow of current to drive the motor is interrupted.
 5. An electric hoist or pulley block comprising an electric motor having an axially displaceable frusto-conical armature, a first winding and a second winding which are controlled by a switch and adapted to effect substantially equal axial displacement of the armature, whereby a main lift and an inching lift are provided, the armature speeds obtained by the main lift and inching lift windings being in the ratio of 1 to 4 or higher, and a magnetic brake operative against the armature when the flow of electric current to drive the motor is interrupted.
 6. An electric hoist according to claim 5, in which the switch is a two-way hand-operated push-button type, and in a first switch position the connection contacts are connected to a source of electric current, and in which in a second switch position the contact for a change-over relay is actuated which interrupts the current flowing to one armature winding and transfers the current to the other armature winding.
 7. An electric hoist according to claim 6 or claim 7, in which a hoist limit switch, or switches, is or are inserted in the circuit between the hand-operated switch and the change-over relay.
 8. An electric hoist according to any one of the preceding claims, in which the driving motor is a 3000 rev./min. motor with change-pole control, and a roller chain is provided as a lifting member.
 9. An electric hoist according to claim 8, in which the second winding of the motor has at least eight poles.
 10. An electric hoist substantially as hereinbefore described and illustrated in the accompanying drawings.

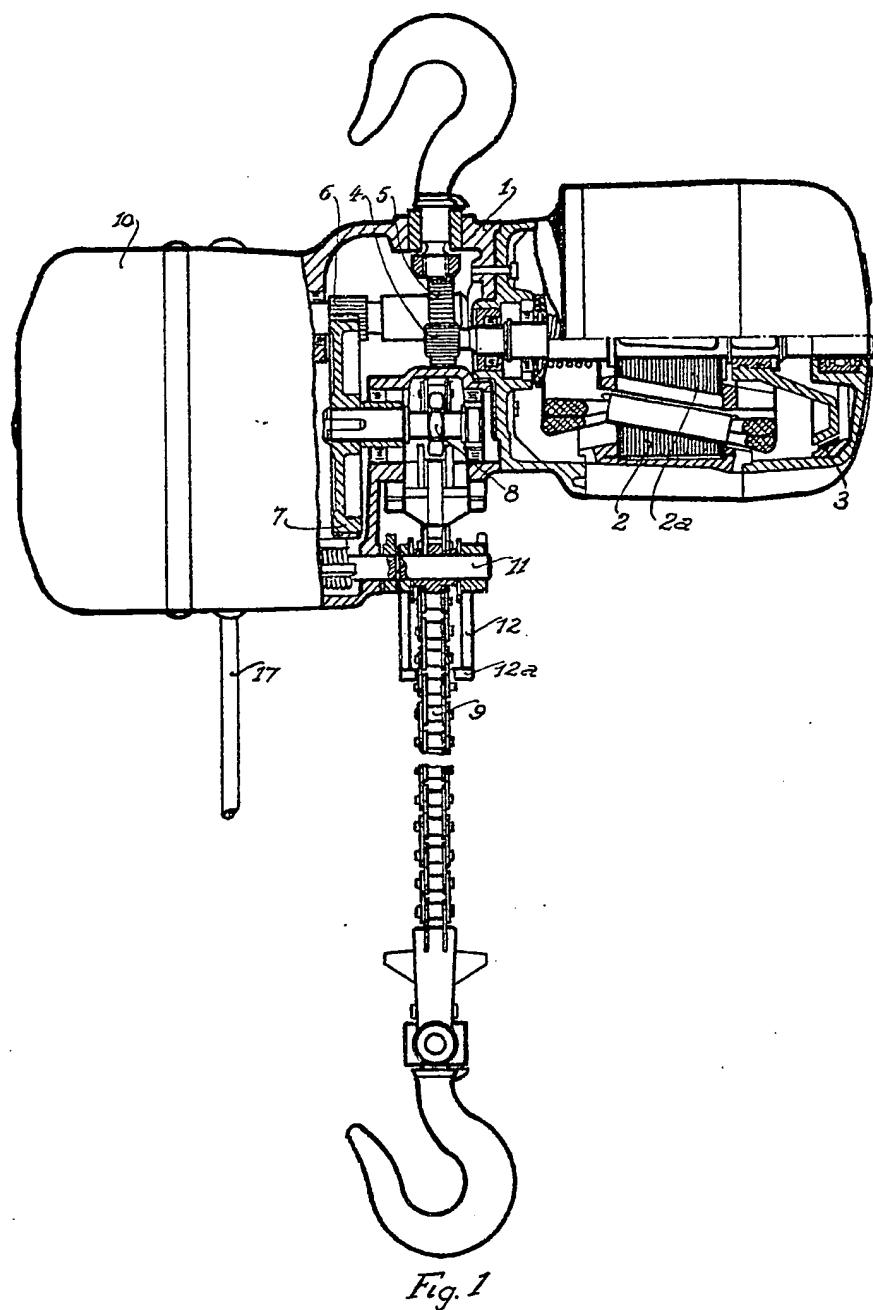
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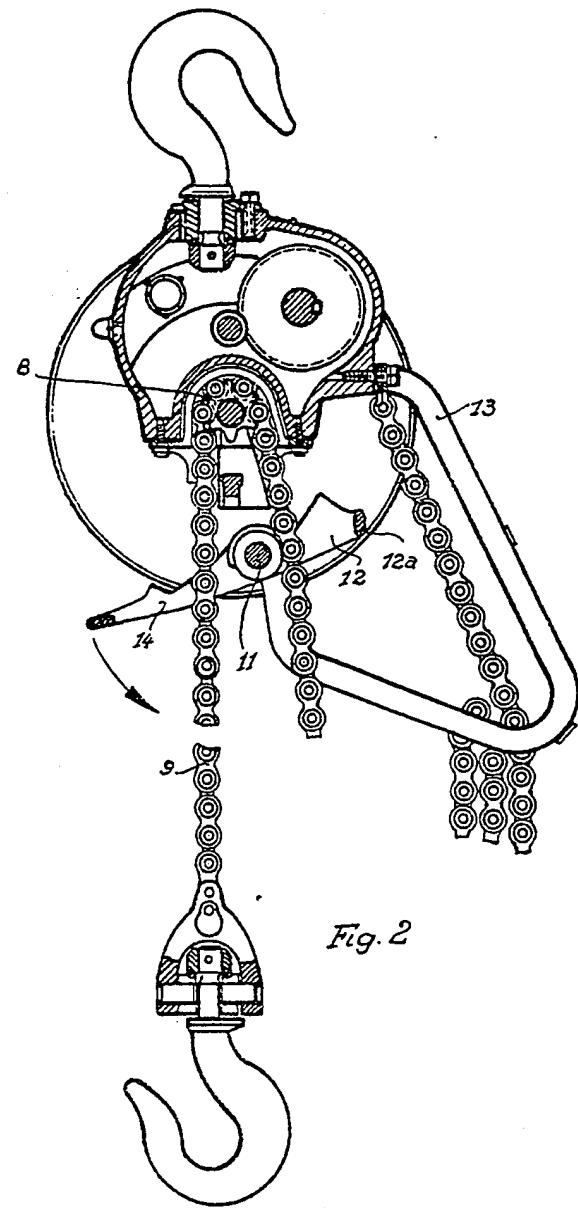
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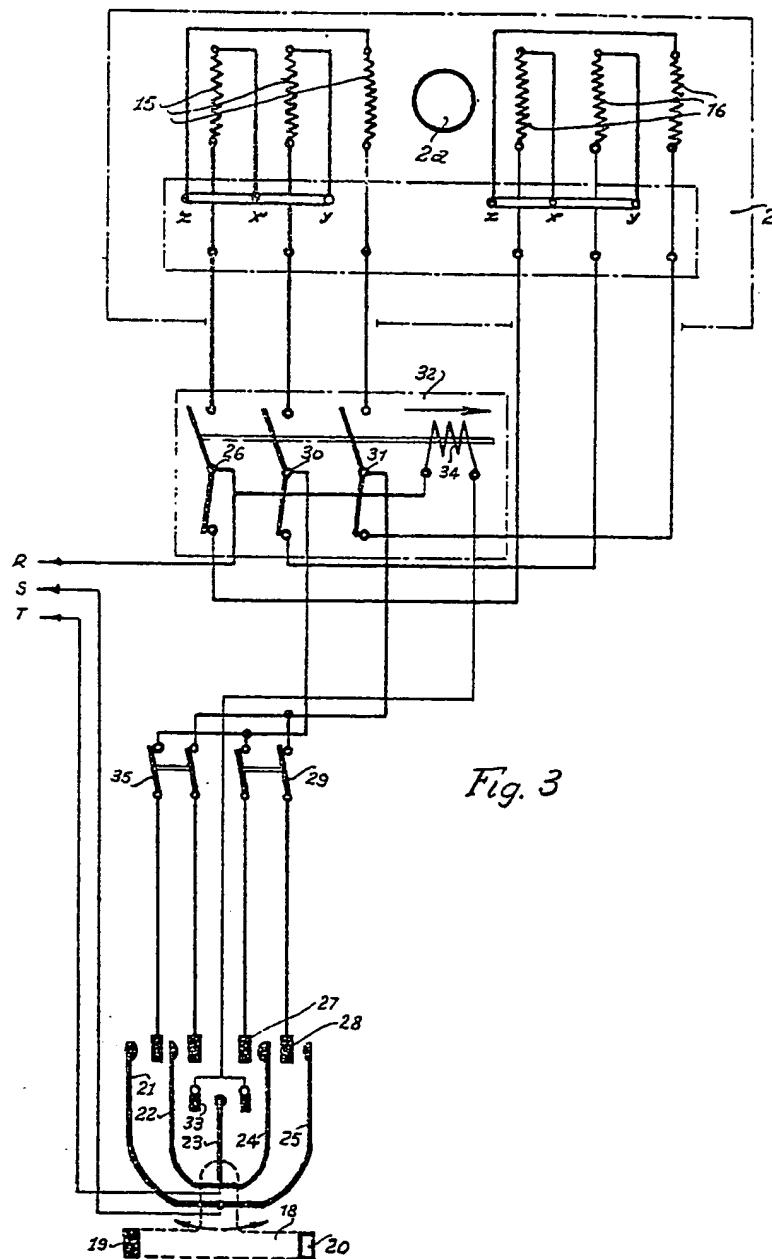
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